



FireLine™ FL200 Solid State UV LED Curing System

User Manual

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September, 2020

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Overview and Safety

UV Curing System Components

The FireLine FL200 system consists of the following components:

- FireLine FL200 Light Source
- Controller
- DC Power Supply
- Cooling Water
- Input Control Signals

The product label on the FL200 light source identifies the production model and configuration. See the example (pictured right):

- FireLine is the product family
- FL200 125x10 is the model number
 - 125 represents the UV emitting length in mm
 - 10 represents the UV emitting width in mm
- Configuration information follows the model number
 - WC defines unit as water-cooled
 - 395 defines the dominant wavelength in nm
 - 20W defines the peak irradiance in W/cm^2

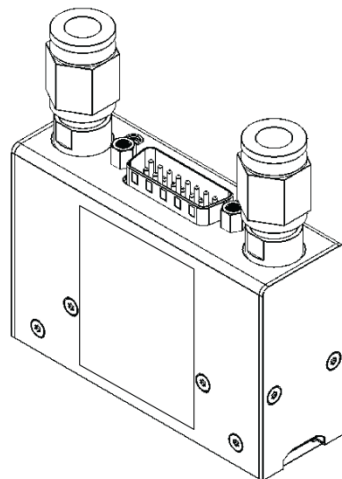


Figure 1.1: Light Source Safety Label Placement (safety label on back of product)

CAUTION: The window frame may become a hot surface during UV operation.

Product Safety Information

UV LED Curing Sources



Intended Use

Phoseon light sources and optional power supplies are supplied as “open type” equipment. These system components must be mounted within an enclosure that is suitably designed for the specific environmental conditions present for the final product, and appropriately designed to prevent personal injury resulting from accessibility to live parts.

Protective Guards

Phoseon light sources include protective guards to fully enclose electrical mechanisms that may cause operator harm during normal use. These fixed guards adhere to the appropriate international safety standards.

CAUTION: Do not operate the light sources or the machine in which they are installed while any safety guards are open, loose, damaged, or missing.

Phoseon light sources are classified as Risk Group 3 under IEC 62471 at a distance of 200mm.

Risk groups defined in IEC 62471:

Exempt - There is no photo-biological hazard for the end points in this standard.

Risk Group 1 - Low Risk. Does not pose a hazard due to normal behavioral limitations on exposure.

Risk Group 2 - Moderate Risk. Does not pose a hazard due to aversion response to very bright light sources or due to thermal discomfort.

Risk Group 3 - High Risk. May pose a hazard even for momentary or brief exposure.

WARNING: DO NOT LOOK DIRECTLY AT THE UV LIGHT SOURCE WITHOUT WEARING UV SAFETY GOGGLES.

Note: A portion of the UV light will be visible and will be a strong visual stimulus.

Minimum requirement: UVEX SCT-orange lens which reduces eye fatigue by absorbing blue and green light and allows the operator to clearly view components during curing and inspection processes while absorbing 99.9% of UV radiation and visible light up to 532nm.

Note: Phoseon UV LED products emit 90% or more of the total UV light energy in a narrow wavelength band:

Wavelength	Band
365nm	345 to 385nm
385nm	370 to 410nm
395nm	380 to 420nm
405nm	390 to 430nm

Hazard and Safety Notices

The symbols and labels in the following table are used in Phoseon's light source product documentation and on the product labels. Please familiarize yourself with the symbols and their meaning in order to avoid misuse of the product.

Table 1.1: Safety Notices

Symbol	English Description	French Description	Italian Description	German Description	Spanish Description	Dutch Description	Polish Description
	Safety Notices	Consignes de Sécurité	Avvertenze sulla sicurezza	Sicherheits-hinweise	Notas de Seguridad	Veiligheids-aanduidingen	Ostrzeżenia dotyczące bezpieczeństwa
	Attention Read manual for safety instructions	Attention Lisez les instructions de sécurité dans le manuel	Attenzione Leggere il manuale per le avvertenze sulla sicurezza	Achtung Bitte Vorsichtsmaßnahmen in der Gebrauchsanleitung lesen	Atención Lea el manual de Instrucciones de seguridad	Opgelet Lees handleiding voor veiligheidsvoorschriften	Uwaga Zapoznaj się z zaleceniami bezpieczeństwa w instrukcji
	UV Light Read manual for safety instructions	Lumière UV Lisez les instructions de sécurité dans le manuel	Luce UV Leggere il manuale per le avvertenze sulla sicurezza	UV LICHT Bitte Vorsichtsmaßnahmen in der Gebrauchsanleitung lesen	Luz UV Lea el manual de Instrucciones de seguridad	UV-licht Lees handleiding voor veiligheidsvoorschriften	Promieniowa- nie UV Zapoznaj się z zaleceniami bezpieczeństwa w instrukcji
	Hot Surface	Surface Chaude	Superficie calda	Heiße Oberfläche	Superficie Caliente	Heet oppervlak	Gorąca powierzchnia
	Warning RISK GROUP 3 UV EMITTED FROM THIS PRODUCT Avoid eye and skin exposure to unshielded product.	Avertissement Rayonnement UV À Risque de Groupe 3 Eviter l'exposition des yeux et de la peau sans protection adéquat.	Attenzione DA QUESTO PRODOTTO EMISSIONI UV DELLA CLASSE DI RISCHIO 3 Evitare l'esposizione di occhi e pelle al prodotto non schermato.	Warnung Dieser Strahler emittiert UV-Strahlung der Risikogruppe 3. Setzen Sie Haut und Augen nicht der Strahlung des nicht abgeschirmten Strahlers aus.	Advertencia RADIACION UV DE RIESGO GRUPO 3 EMITIDA POR ESTE PRODUCTO Evite la exposición de ojos y piel por el producto sin protección adecuada.	Waarschuwing UV-STRALING RISICOGROEP 3 UITGEZONDEN VAN DIT PRODUCT Vermijd blootstelling van ogen en huid aan niet-afgeschermd product.	Ostrzeżenie GRUPA ZAGROŻENIA 3 PRODUKT EMITUJE PROMIENIOWANIE UV Unikać wystawiania skóry i oczu na działanie nieosłoniętego produktu.

Similar to the ANSI Z535.4 standard, the ISO 3864-2 standard defines the hazard severity panels as follows:

Yellow safety alert symbol Indicates possible human injury hazard exists.



DANGER signal word: used to indicate an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING signal word: used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION signal word: used to indicate a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.



Restriction of Hazardous Substances (RoHS)

Phoseon Technology declares, to the best of our knowledge based on available information conducted to us, that our light sources do not contain any homogeneous materials that:

- Contains lead (Pb) in excess of 0.1 weight -% (1000 ppm)
- Contains mercury (Hg) in excess of 0.1 weight-% (1000 ppm)
- Contains hexavalent chromium (Cr VI) in excess of 0.1 weight-% (1000 ppm)
- Contains polybrominated biphenyls (PBB) or polybrominated dimethyl ethers (PBDE) in excess of 0.1 weight-% (1000 ppm)
- Contains cadmium (Cd) in excess of 0.01 weight-% (100 ppm)

Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

Phoseon Technology has determined our products are not subject to EU REACH directive registration requirements.

With regards to the projected candidate list of substances of very high concern (SVHC) - issued 10 October 2008, Phoseon Technology further declares that, to the best of our knowledge, our products do not contain any currently listed SVHC above the level 0.1% by weight.

Product Recycling

This symbol is an internationally agreed indicator that the product bearing it should not be disposed of as general waste or garbage which might end up in landfill sites, but should instead be returned to Phoseon for reuse or be disposed of in accordance with local laws.

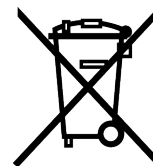


Figure 1.1: Do Not Dispose in Trash Symbol

Setup & Installation

Refer to the following documents for detailed information regarding integration into OEM equipment.

Table 2.1: FireLine FL200 Documentation

FireLine FL200	75x10		125x10	
Product Specification	30557			
Tech Note, Scaling Light Sources	30630			
Control Drawings, Light Sources	29750		29749	
Control Drawing, Controller	30391			
DC Power Cable, 2m	39339			
Water Cooling Requirements	28384			
Reducing Light Reflection	28658			
Window Cleaning Instructions	27182			
Declaration of Conformity	29321			
Ethernet Protocol User Manual	30501			
Optional Power Supplies*	Mean Well www.meanwell.com RSP-960-48 Phoseon PN: 30454	Mean Well www.meanwell.com RSP-2400-48 Phoseon PN: 29879	Mean Well www.meanwell.com RSP-3000-48 Phoseon PN: 20011	

*For systems that require EMC testing, the Mean Well power supplies are not recommended.

With the exception of the 3rd party power supplies and the *Ethernet Protocol User Manual*, the above documents are included in this manual and also available as individual documents on the Phoseon Customer Resource Center (CRC) website at www.phoseon-support.com.

If using the optional power supply, or any 3rd party power supply, refer to the manufacturer's website for up to date dimensions and specifications. Particularly note any derating needed for operation in the target environment.

Electrical

The FireLine FL200 system, which includes light source(s) and controller, requires a switching power supply with constant voltage output. The power supplies tested by Phoseon for FireLine FL200 system are the Mean Well RSP-960-48, RSP-2400-48 and RSP-3000-48. The Mean Well specifications can be used as a guideline for selecting a switching power supply with the following critical specifications:

- 48VDC +/- 4V delivered to the light source from constant voltage output source.
- 432 to 2880W minimum, for up to four light sources on a single controller, delivered based on configuration (see 30557 Product Specifications).
- Maximum ripple should be less than 4V peak-to-peak.

A power supply should be used that provides a Safety Extra Low Voltage (SELV) output and that is certified by a notified body and / or CE mark.

Mechanical Installation

Refer to the Control Drawings for the specific FireLine FL200 model or Controller for detailed dimensions and mounting point information. Make special note of the following information listed on the Control Drawing:

- Quantity and size of mounting hardware
- Maximum depth of mounting hardware

Refer to the Product Specifications document for the following information:

- DC power/Data connector (manufacturer and model)
- DC power/Data connector Pinout

CAUTION: The light source may be damaged if these specifications are not followed.

FireLine™ FL200

Product Specifications



Phoseon UV LED SLM™ Technology

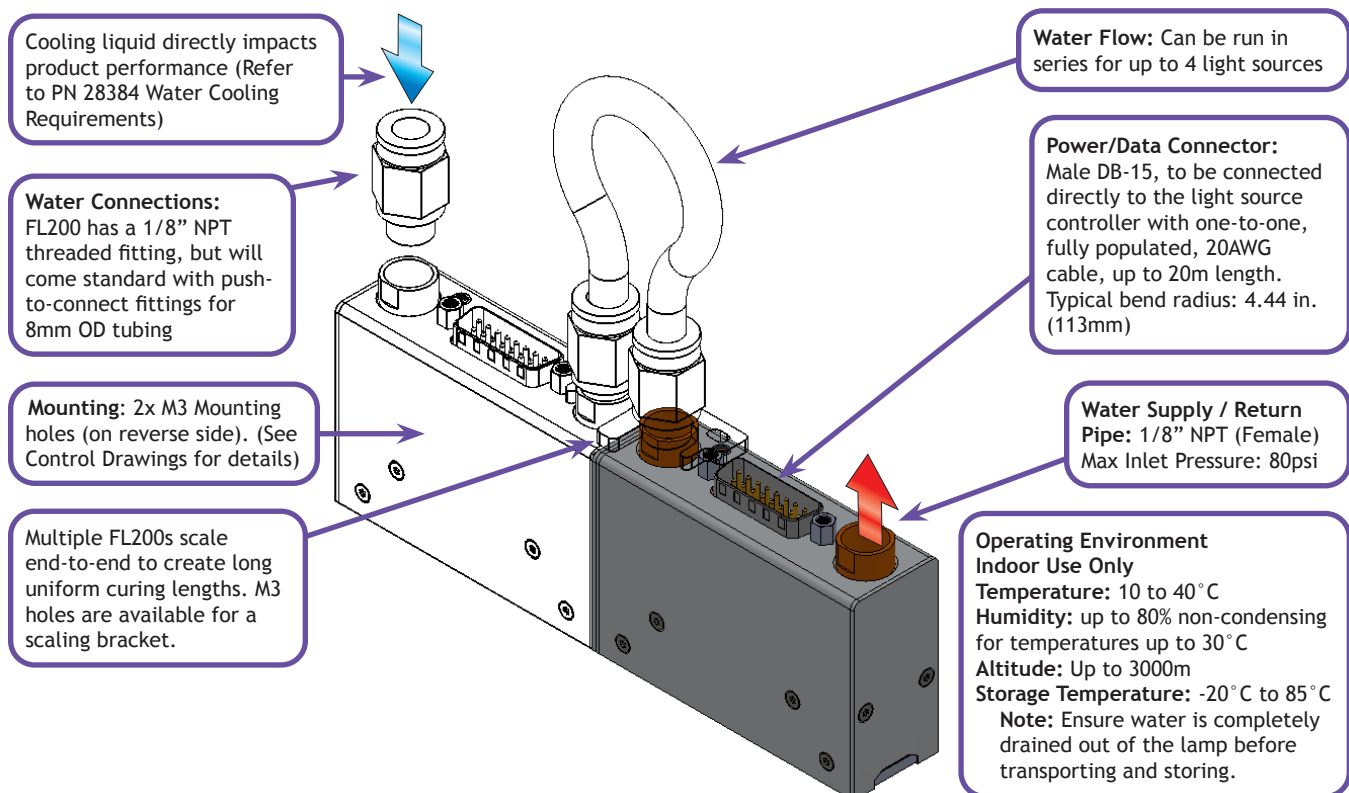
Phoseon Technology is the world leader in providing UV LED solutions for commercial and industrial applications. Phoseon's products deliver superior performance and real-world reliability for UV curing of adhesives, coatings and inks.

Phoseon's patented Semiconductor Light Matrix (SLM)™ technology encapsulates LEDs, arrays, optics and cooling to maximize UV LED curing performance. The FireLine™ FL200 light source is for use in high performance curing on cylindrical objects.

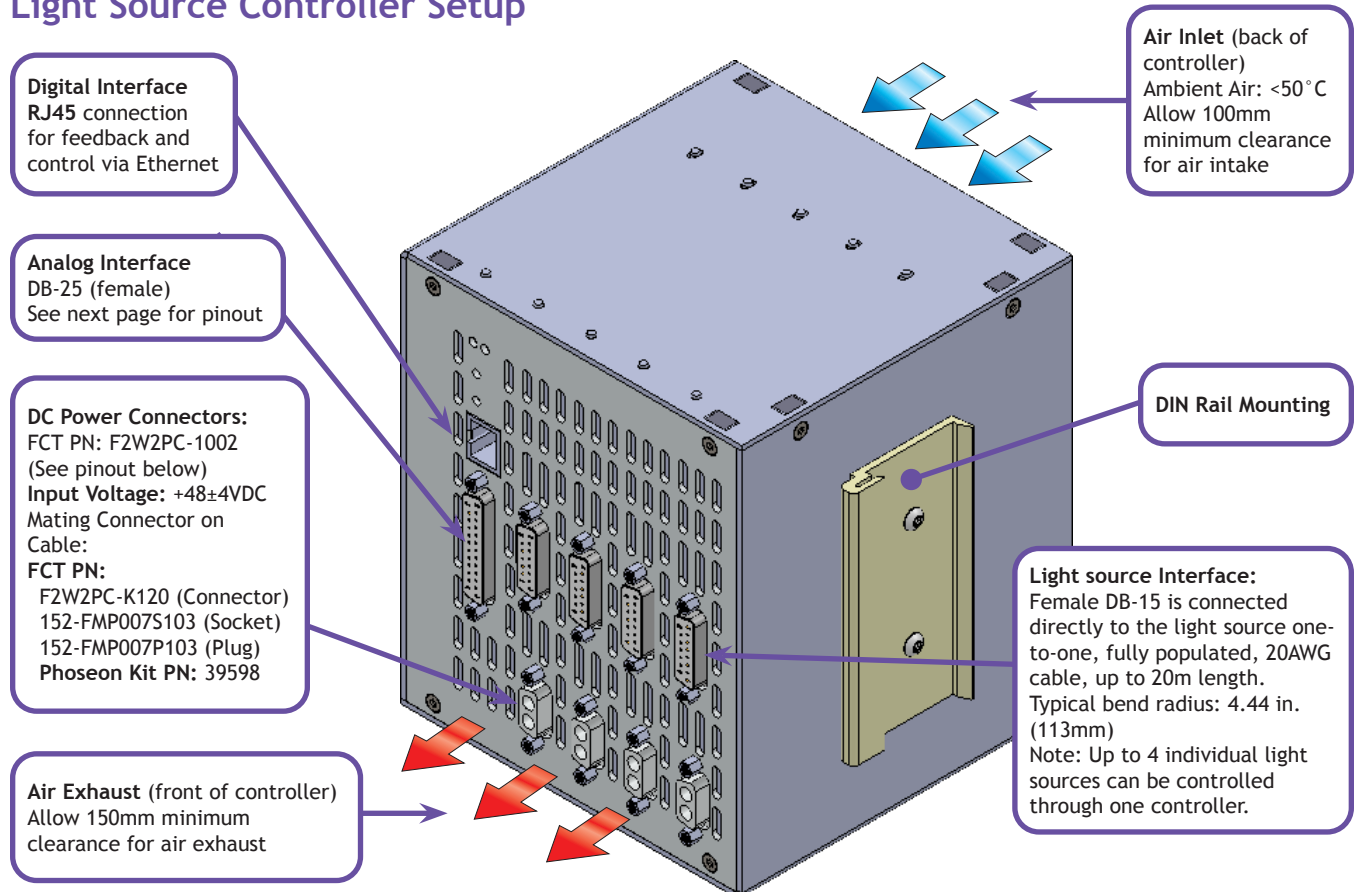
Performance

	365nm		385, 395, 405nm	
Peak Irradiance	10W/cm ²		25W/cm ²	
Emitting Window (mm)	75x10	125x10	75x10	125x10
48V Power In (Max)	290W / 6.0A	480W / 10.0A	432W / 9.0A	720W / 15A
Chiller/Cooler Capacity	235W	395W	360W	540W
Chiller/Cooler Flow Rate	2LPM	2LPM	2LPM	2LPM
Pressure Drop	0.02 Bar / 0.29 psi	0.02 Bar / 0.29 psi	0.02 Bar / 0.29 psi	0.02 Bar / 0.29 psi

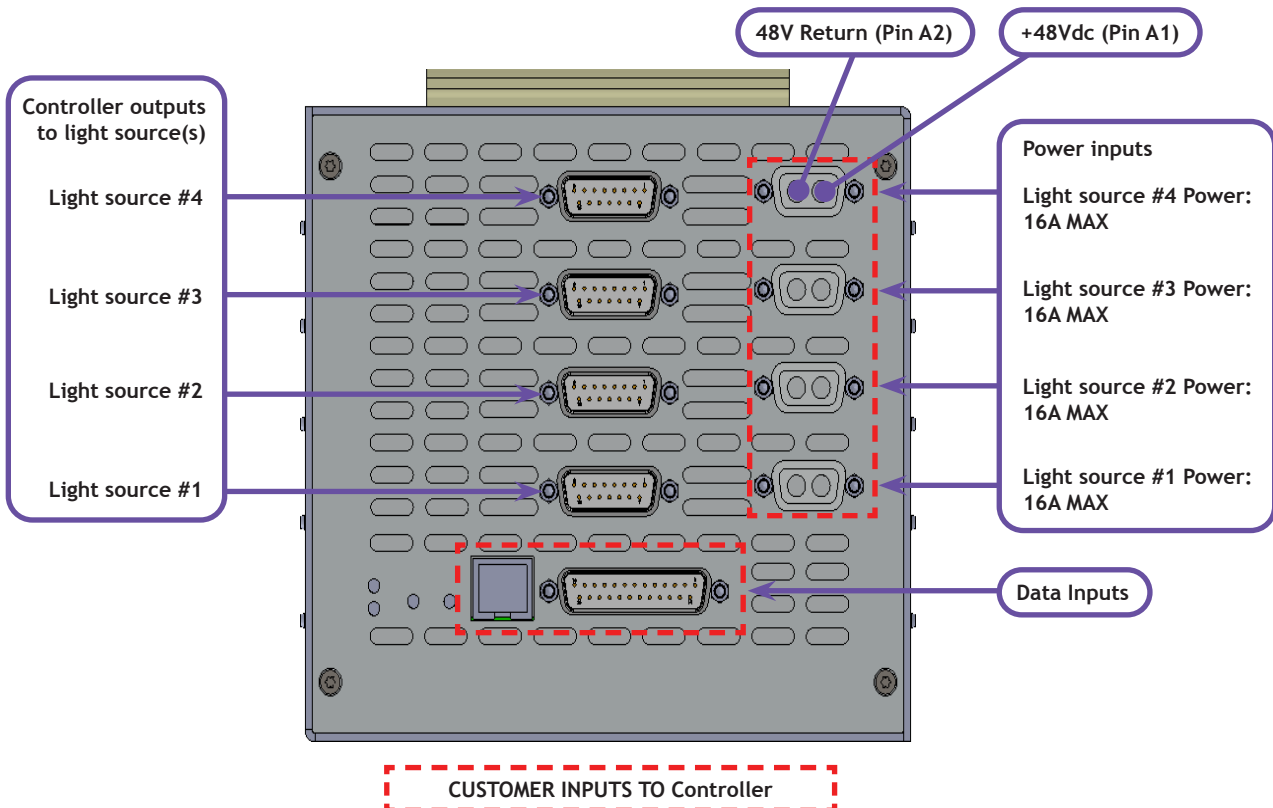
Light Source Setup



Light Source Controller Setup



Controller Outputs To Light Source(s)



Scaled Systems

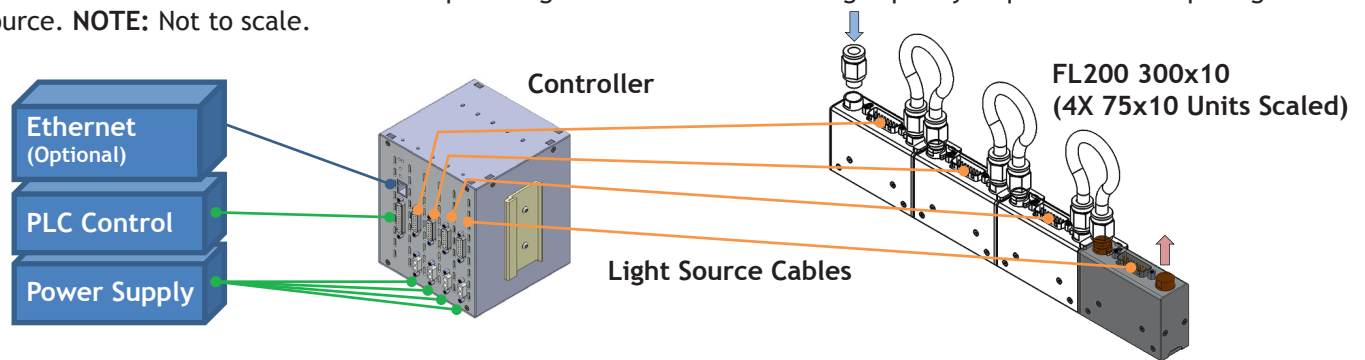
Light Sources are scaled by mounting them end-to-end, to create multiple cure lengths as shown below. Note that a single light source controller will control up to 4 light sources. For systems using more than 4 light sources, additional controllers are required.

		125x10mm				
		0	1	2	3	4
75 x 10mm	0	x	125	250	375	500
	1	75	200	325	450	575
	2	150	275	400	525	650
	3	225	350	475	600	725
	4	300	425	550	675	800

Systems with > 4 light sources require additional controllers

Setup Example

Water flow can be used in series with up to 4 light sources. Water cooling capacity requirements are per light source. **NOTE:** Not to scale.



PLC Interface

+24V Reference: (see equivalent circuit in diagram)
Do not use except to provide 24V directly back to the light source. Cannot be used with multiple controllers.
Max Current = 10mA

Controller Ready/UV Override: (Dual Purpose Pin - Input/Output)

Input:

- Pulled low to ground = UV override (**DO NOT APPLY VOLTAGE TO THIS PIN**)

Output:

- +16V to +24V = UV Emission Allowed
- 0V to +6V = UV Emission Stopped

Max Sync Current = 20mA

Enable High: (24V PLC Input)

0 to 6V (ground/open input) = OFF or 16 to 24V = ON
Internal resistive load on this pin is 125kΩ

Intensity Control: (Voltage Input: 0.1V-10V)

0.1V = 1% of full power, 10V = 100% of full power
Internal resistive load on this pin must be >100kΩ

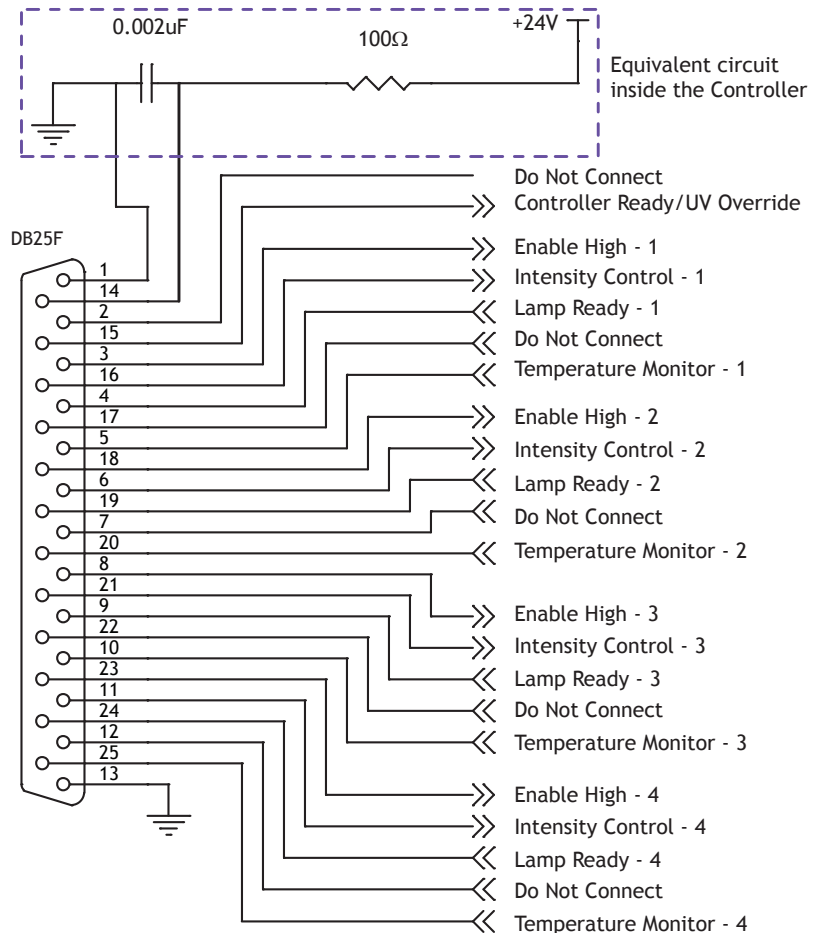
Lamp Ready: (24V PLC Output)

0 to 6V = Not Ready or 16 to 24V = Ready
External resistive load on this pin must be ≥10kΩ

Temperature Monitor: (Voltage Output)

Voltage proportional to heat sink temperature
0.1V = 1°C

External resistive load on this pin must be ≥10kΩ

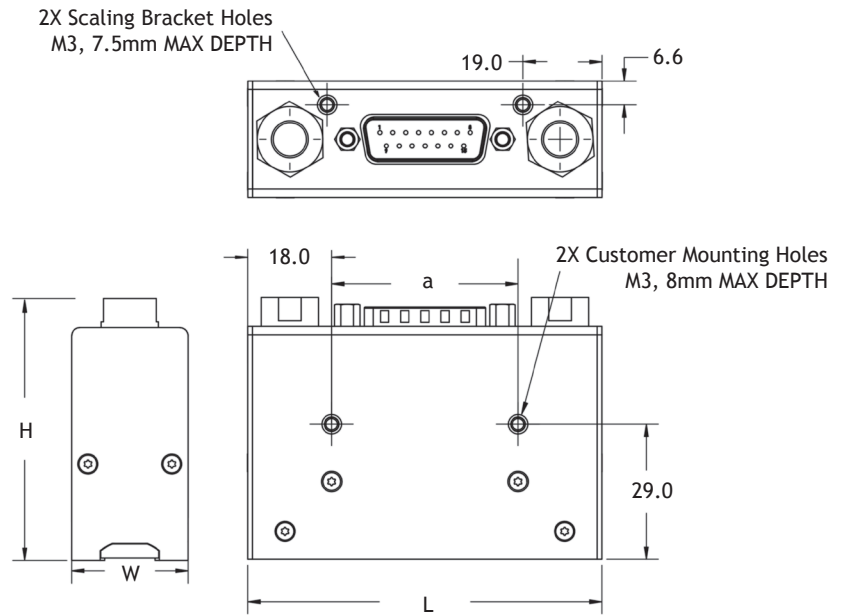


Dimensions

Units of measurement: mm

Light Source		
UV Emitting Window	75x10	125x10
L	76	126
W	25	
H	56.21	
H*	79.3	
a	40.0	90.0
Weight (kg)	0.26	0.38

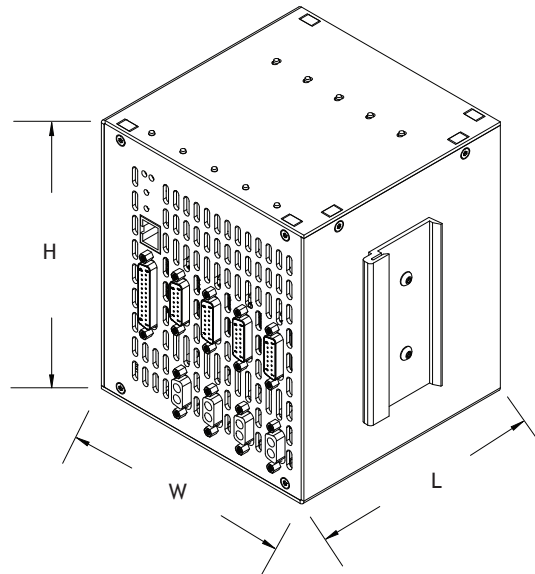
*Height with optional push-to-connect water fittings.



Units of measurement: mm

Controller	
L	104.7
W	144.5
W*	153.0
H	167.0
Weight (kg)	.64

*Width with optional DIN rail mount.

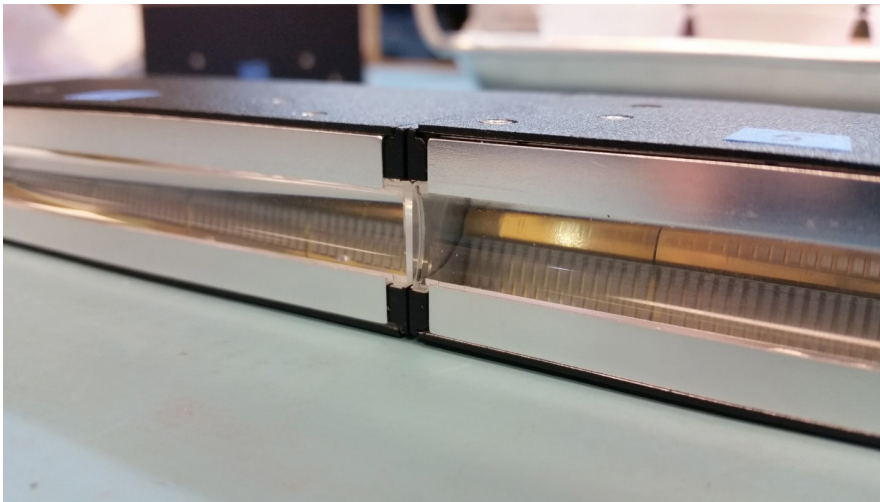


FireLine™ FL200 Scaling Systems

Technical Note



Multiple FireLine™ FL200 light sources can be scaled end-to-end to create long uniform curing lengths. A single controller will provide power and control for up to four light sources, and water can be run in series for up to four light sources. For systems using more than four light sources, additional controllers and additional water inputs are required. Exercise caution when aligning and securing light sources together to avoid chipping the emitting window.

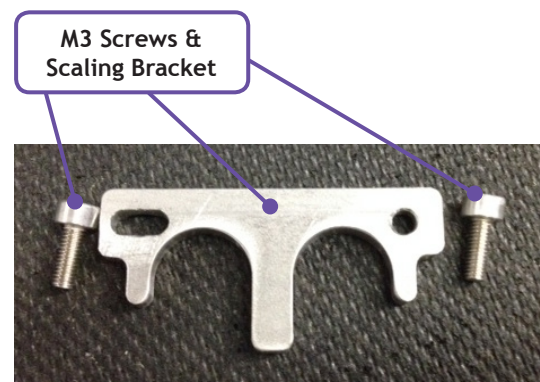


Scaling Alignment

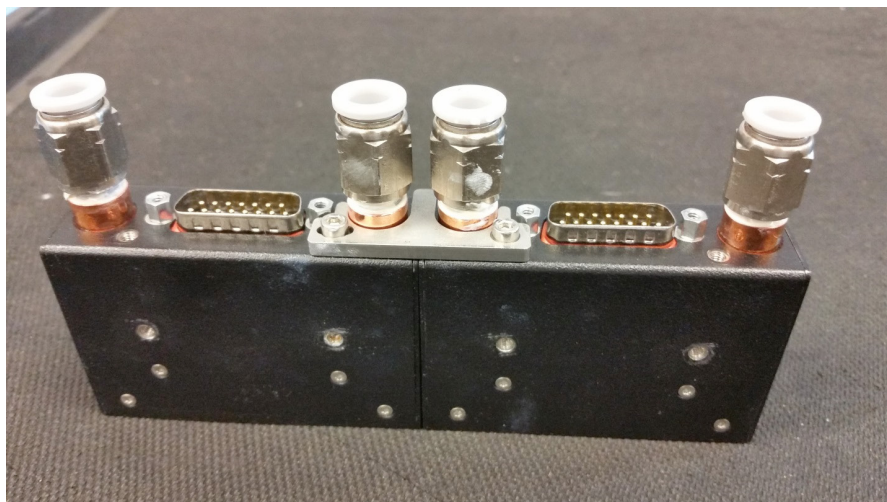
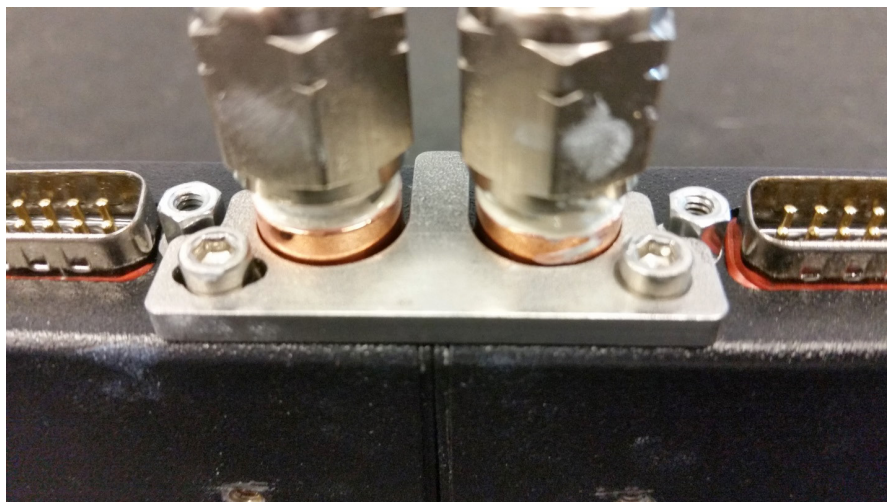
1. With the light sources vertical (lens down), place the **scaling bracket** (**Scaling Bracket Kit, PN30419**) on the top (connector) surface such that it “captures” the adjacent water pipes.

Note: Included with each Scaling Bracket Kit is a daisy-chain water tube.

2. Secure with M3 screws.



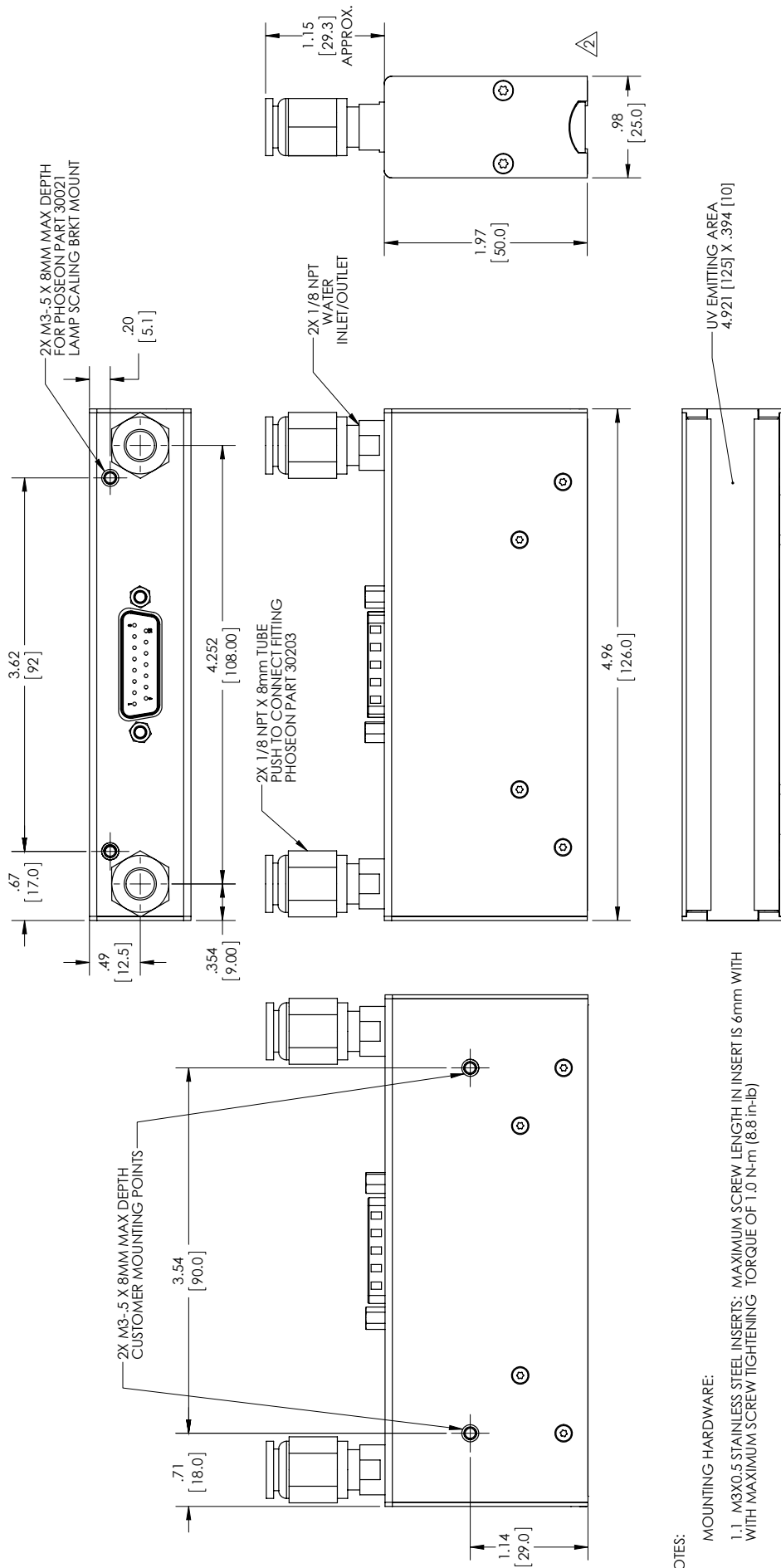
The installed scaling bracket is shown below.



The installed daisy-chain water tube is shown below. Repeat this process to scale additional light sources.



REVISONS					
REV.	DESCRIPTION	ENGR	DATE	ECO	APPROVED DATE
1	INITIAL RELEASE	GLM	12/04/14	1426	PH 01/16/15
2	ELIMINATED ALIGNMENT TAPPED HOLES	GLM	9/1/2016	1918	BS 09/14/16



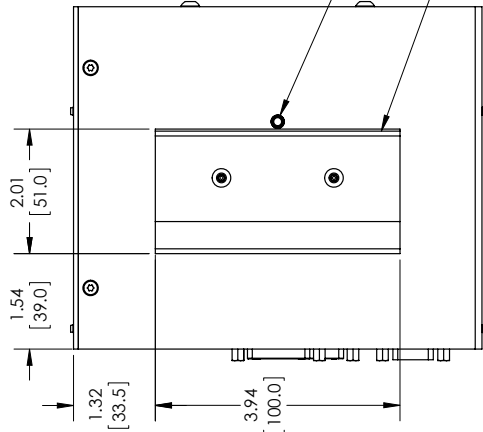
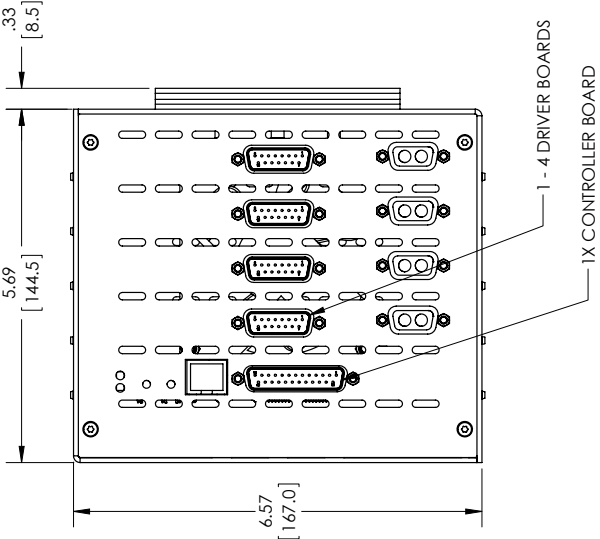
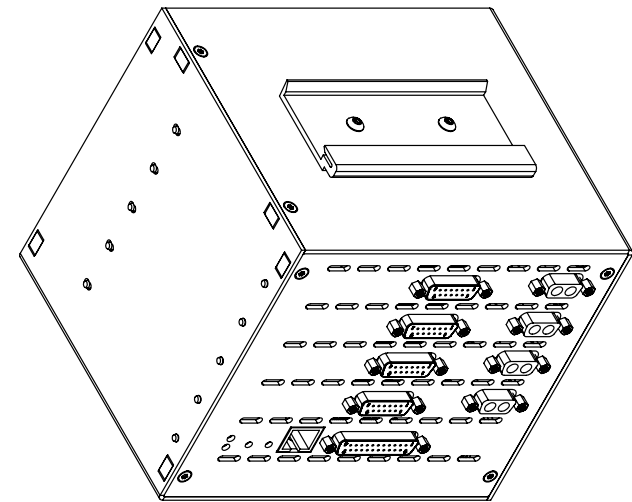
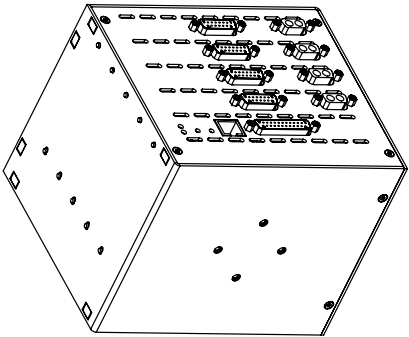
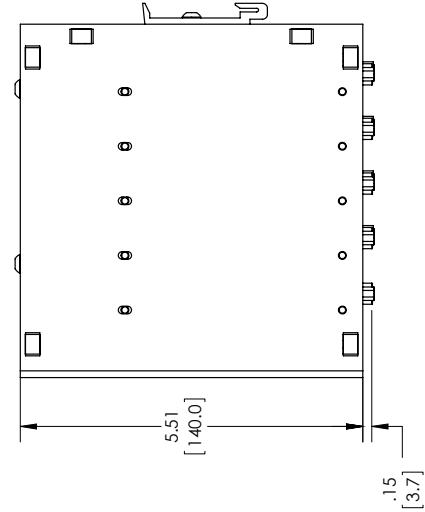
NOTES:

- MOUNTING HARDWARE:
 - M3X0.5 STAINLESS STEEL INSERTS: MAXIMUM SCREW LENGTH IN INSERT IS 6mm WITH MAXIMUM SCREW TIGHTENING TORQUE OF 1.0 N-m (8.8 in-lb)
- REFERENCE DOCUMENTS:
 - 28384 WATER COOLING REQUIREMENTS
 - 29758 PRODUCT SPECIFICATIONS

3RD ANGLE VIEW	MATERIAL: NOIED	FINISH: N/A	TITLE: CONTROL DRAWING, FL200 125X10
Phoseon TECHNOLOGY			
PROPRIETARY AND CONFIDENTIAL THIS DRAWING IS THE SOLE PROPERTY OF PHOSEON TECHNOLOGY. ANY REPRODUCTION OR TRANSMISSION OF THIS DRAWING WITHOUT THE WRITTEN PERMISSION OF PHOSEON TECHNOLOGY IS PROHIBITED.			
DIMENSIONS IN INCHES DIMENSIONS IN MILLIMETERS OTHERWISE SPECIFIED XX-00.00 (0.25) XXX-00.00 (0.50) XXXX-00.00 (1.00) ANGLE ±1°			
PART NUMBER: 29749 ISSUED BY: G. MCKENZIE 30 DATABASE: 29749 Rev 2 Control Drawing, FL200 125X10 SEP ASME/ANSI Y14.5, EGF 44274-01 SCALE: 1:1 SIZE B1 SHEET 1 OF 1			REV. 2 ISSUE DATE: 12/4/2014

REVISIONS

REV.	DESCRIPTION	ENGR	DATE	ECO	APPROVED	APPROVED DATE
1	INITIAL RELEASE	GLM	12/12/14	1427	OM	1/13/15



- NOTES:
1. WEIGHT = 2.3 LBS DEPENDING ON DRIVER BOARD LOADING.

3RD ANGLE VIEW	MATERIAL: SEE BILL OF MATERIALS TABLE	FINISH: SEE BILL OF MATERIALS TABLE	TITLE: CONTROL DRAWING, CONTROLLER, 5 BOARD, FL200
PHOSEON TECHNOLOGY			PART NUMBER: 30391
ISSUED BY: G. MCKENZIE			ISSUE DATE: 1/11/2014
30 DATABASE: 30391 Rev. 1 Control Drawing, Controller, FL200STEP			ASME/ANSI Y14.5, EGF 44274-01 SCALE: 1:1 SIZE B 1 SHEET OF 1

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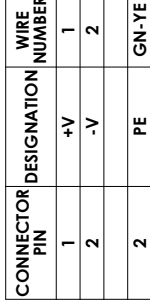
1. CABLE ASSEMBLY SHALL BE ASSEMBLED PER COMPONENT MANUFACTURER'S RECOMMENDED PROCEDURES. ALL CRIMPED WIRE TERMINATIONS SHALL PASS MANUFACTURER'S CRIMP HEIGHT AND PULL TEST REQUIREMENTS.

3. THE CLAMP-ON-FERRITE MUST FIT FIRMLY AROUND THE CABLE ASSEMBLY. A TIE WRAP OR HEAT SHRINK TUBING OR A NYLON SPACER CAN BE USED ADJACENT TO THE CLAMP-ON FERRITE TO FIX IN PLACE.

5 ATTACH GROUND WIRE TO -V ITEM 3 TERMINAL ON CONNECTOR

6. > PERMISSIBLE TO SUBSTITUTE CRIMP CONTACTS FOR ITEMS 3 (FMP004P103) AND 4 (FMP004S103).

8. APPLY 1" HEATSHRINK ITEM 10 TO +V WIRE INSIDE CONNECTOR TO COVER EXPOSED CONTACT TO PREVENT BACKFEED SUPPORTING. APPLY 1" HEATSHRINK ITEM 7 TO CABLE AT CONNECTOR END.



PART NUMBER	LENGTH IN METERS
39339	2M
39449	5M
39450	10M
39451	20M

ITEM	PHOSCON P/N	REV	MFG.	MFG P/N	DESCRIPTION	QTY	CRIT COMP
1	[50475]		TE CONNECTIVITY	1-2308340-1	BACKSHELL, HD DB15, KIT	1	YES
2	[29256]		FCT	FW22PC-K120	CONN, 2-PIN, PLUG, POWER, DB9	1	YES
3	[36267]		MOLEX	177040153	Contact Pin, 40A Socket D-Sub, Crimp	1	YES
4	[50474]		MOLEX	177040145	CONTACT, Male, 40A, Crimp	1	YES
5	[39313]		HELUKABEL	16428	CABLE 3 CON, SHIELDED, 10 AWG, PVC	AR	
6	[10568]		HELLERMAN-TYTON	TA99L-105-WH EPS300 1/2 BLACK	LABEL, SELF LAMINATING, 1 X 3/4,	1	
7	[27686]		3M		Tubing, Heatshrink, 1/2", BLK w/Adhesive	AR	
8	[19709]		STEWART	28A2024-0A2	FERRITE, TUBE BOX CLAMPON, .500 BLK	1	
9	[39315]		PANDUIT	PN10-8R-D	CRIMP, RING TERM, 12-10 AWG, #8	3	
10	[36261]		3M	EPS300-3/8" RD	TUBING, HEATSHRINK, 3/8", RED	1	
11	[26859]		3M	EPS300 3/16"	TUBING, HEAT SHRINK, 3/16", BLACK, ADHESIVE	AR	
12	[39466]		MUELLER	1351003	(Alternate) Cable, 3 CON, Shielded, 10 AWG	1	
13	[50476]		TE CONNECTIVITY	1-2308272-4	CABLE CLAMP, D-SUB, 4	1	

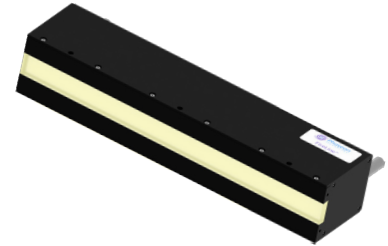
Water Cooling Requirements



Technical Note

Overview

Phoseon offers several water-cooled light sources. Water cooling is the most efficient way to remove excess heat from any device. Water cooling is a closed system, consisting of water channels internal to the light source, an external cooler or chiller, and the water lines connecting the two. The cooling water runs through the light source to transfer heat away from the UV LEDs, and the chiller or cooler then removes the excess heat from the water before it is circulated back to the light source.



Proper setup and regular maintenance of the water cooling system is a requirement of the Phoseon warranty. Failure to follow the requirements listed below can result in permanent damage to the light source. This document supersedes any recommendations or requirements in the Cooling Water or Water Condensation Hazard sections of the product manuals.

Warranty Requirements

The following requirements must be met to maintain the optimum performance of the light source. Failure to meet these requirements voids the warranty.

The water chiller must meet the flow rate and cooling capacity requirements of the Phoseon light source. Flow rates and cooling capacities are listed on the product specification sheets and in the OEM manuals.

- **Use distilled water only.** Do not use tap water or deionized water. They are harmful to the cooling system.
- **Use an anti-corrosion additive.** Water is very corrosive to metals, so protection against corrosion is essential.
- **Avoid conditions that cause condensation** to form on the water lines and inside the light source.
- **Use a flow switch** or other safeguard to insure the light source is not enabled without cooling water.

See below for additional details on these requirements.

Water Preparation

Use distilled water only

The minerals typically found in tap water are detrimental to the cooling system, and in extreme cases will cause complete blocking of the water channels inside the light source. Do not use deionized water in the cooling system. Deionized water is extremely corrosive, and will quickly degrade the water channels.

Use an anti-corrosive additive

Anti-corrosion additives are required to keep the water channels clear. Using distilled water alone reduces, but does not eliminate, the build-up of deposits in the channels due to galvanic corrosion. A convenient way to add anti-corrosion ingredients to the water cooling system is through the use of readily available coolants (anti-freezes). Most coolants contain proprietary anti-corrosion additives which are effective in preventing deposits. Simply verify that the coolant is specified to provide protection for multiple metals, including copper, aluminum and brass.

Coolant requirements:

- Type: DowFrost™ Heat Transfer Fluid or equivalent
- Concentration of Propylene Glycol: 96% before dilution
- Coolant/Distilled water mix: 25%-30% concentration, remainder distilled water
- Protection for multiple metals, including copper, aluminum and brass

Propylene glycol based coolant is also classified as non-toxic and is available worldwide. In addition, a coolant mixture of at least 25%, as required by Phoseon, eliminates the need for an algaecide. However, do not use a mixture of more than 30% coolant, as it will reduce the cooling capacity by too great an amount.

In some environments, a 25% to 30% concentration of coolant produces foam in the cooling water, lowering the cooling efficiency. If foam is present in the cooling water, an alternative is a 20% concentration along with an algaecide.

Be aware that the chiller manufacturer may require specific additives in order to remain under their warranty. Always check with the chiller manufacturer before using a coolant.

Phoseon has tested:

DowFrost™ Heat Transfer Fluid

- Concentration of Propylene Glycol: 96% before dilution
- Coolant/Distilled water mix: 25%-30% concentration, remainder distilled water

Phoseon has tested:

PolyScience Lab Algaecide

General purpose lab algaecide.

- Dosage: 20 drops/gal
- 8 oz. (treats 400 gallons)

Understanding Condensation

Condensation must be avoided under all conditions. If water collects inside the light source or other equipment, permanent damage will result. It is therefore important to be aware of ambient conditions that lead to condensation.

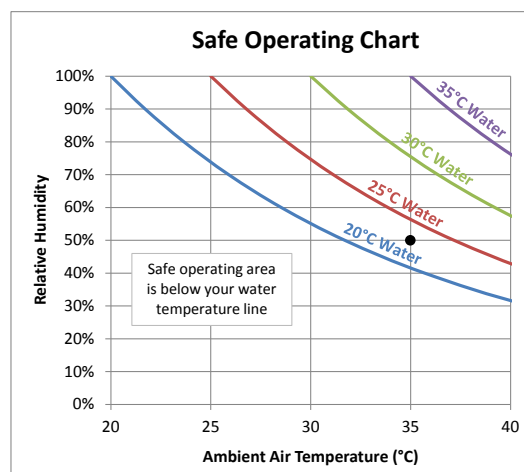
Dew point

Condensation occurs when humid air makes contact with a colder surface. If the surface is cold enough, the air cools to the point where it can no longer hold its water vapor. This causes liquid water to form on the surface.

The temperature at which condensation occurs is known as the dew point. For any combination of ambient air temperature and relative humidity the dew point is predictable. Therefore the conditions under which condensation occurs can be avoided.

Risk conditions

Phoseon water cooled products are specified for operation with a water temperature of 20 - 35°C. Refer to the Safe Operating Chart at right. On this chart the water temperature lines indicate where the dew point matches the water temperature. Any combination of relative humidity and ambient temperature that is above a given water temperature line represents a condition where condensation can occur.



Note: Output irradiance will decrease <2% for every 10°C rise in water temperature. All Phoseon light sources are set at the factory using 30°C cooling water.

Phoseon recommends using a higher water temperature of 30 to 35°C to reduce the risk of condensation. As an example suppose the ambient conditions are 35°C and 50% RH, shown as a black dot on the chart. If the cooling water temperature is 20°C there is a risk of condensation. In this case increasing the water temperature to 25°C or higher will avoid condensation.

Look at your water lines for a quick way to determine if your current conditions are causing condensation. If the water lines coming from the chiller are forming condensation, increase the water temperature to eliminate condensation. Note that in extreme conditions, it may be necessary to reduce the ambient temperature and/or reduce the relative humidity to eliminate condensation.

Operating Requirements

Avoid conditions that cause condensation

The chart at right lists the operating environment specifications for Phoseon water-cooled light sources. Select a water temperature based on your maximum ambient air temperature and relative humidity. In addition, it is good practice to turn off the cooling water whenever the UV output is turned off for more than a few minutes. This allows the water channels to adjust to the ambient air temperature, reducing the chances of condensation.

Use a flow switch

As an added safety measure, the use of a water flow switch is required. A flow switch inserted at chiller's water path output will guard against enabling the UV output when the water flow is off. The output of a flow switch is a simple contact closure. By choosing a switch that matches the light source's Interlock or UV Override control pin function, the UV output is disabled when no water is flowing. The flow switch may be replaced by an equivalent function in an integrated control system.

Operating Environment	
Ambient Temp	10 to 40°C
Water Temp	20 to 35°C
Max Relative Humidity	Varies (See below)
w/ 35°C Water	<80% RH up to 37°C ambient <70% RH up to 40°C ambient
w/ 30°C Water	<80% RH up to 32°C ambient <55% RH up to 40°C ambient
w/ 25°C Water	<80% RH up to 27°C ambient <40% RH up to 40°C ambient
w/ 20°C Water	<80% RH up to 22°C ambient <25% RH up to 40°C ambient

Phoseon has tested:

Gems Sensors

Flow Switch part number:

129661 Normally open with no flow (3.7LPM)

129667 Normally closed with no flow (3.7LPM)

129666 Normally closed with no flow (1.9LPM)

Reducing Light Reflection



Technical Note

Overview

One of the many benefits of UV LED technology is divergent light, meaning there is no focal point of the light output. This creates a longer exposure time for media traveling under the light source, and therefore typically higher dose for curing the adhesive, coating, ink or other UV curable material. When the light source is mounted adjacent to a print head, there may be a concern when using very sensitive inks that light could reflect off the media into the print head and begin curing prematurely. This document describes techniques to reduce reflected light.

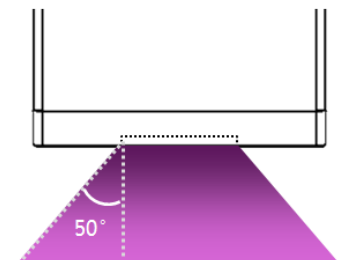
Note:

- The types of print media (surface roughness, reflectivity, color, etc.) will change the behavior and amount of any UV light reflection
- Increasing or decreasing the distance of the light source to the media changes the peak intensity of the UV and may affect cure speed
- Uses of recommendations in this document are done solely at the user's risk; Phoseon claims no responsibility for damage of any inkjet components

Light Output Angle

The typical half angle of light output from Phoseon UV LED light sources with a 20mm wide emitting window is approximately 50° from the edge of the glass.

For products with a 10mm wide emitting window, the half angle varies depending on the type of optic; please refer to the Optics Option Technical Note for more information regarding the shape of the light output.



Half Angle for 20mm products ~50°

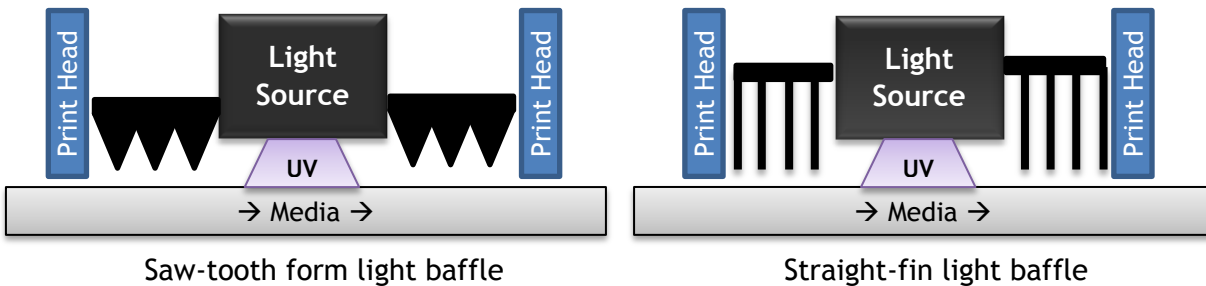
Reducing Light Reflection

To reduce the light reflection, the following techniques can be used:

- Use materials around the light source that absorb or do not reflect UV (examples below) and avoid materials that are good UV reflectors such as bare Aluminum
 - Black anodized or black painted materials
 - Optical absorption and anti-reflective coatings
 - Thorlabs blackout materials, e.g. black metal foil (<http://www.thorlabs.com>)
 - Steel
- Increase surface roughness of materials between the light source and print head
 - Avoid smooth surfaces, which are good reflectors
 - Bead blasting or other roughening techniques reduce reflection of flat surfaces
- Use light traps or baffles between the light source and print heads
 - Saw-tooth forms and straight-fins are good for capturing any reflected light
 - Increase number of grooves and increase depth of baffles
- Keep the light source close to the surface to reduce light spread

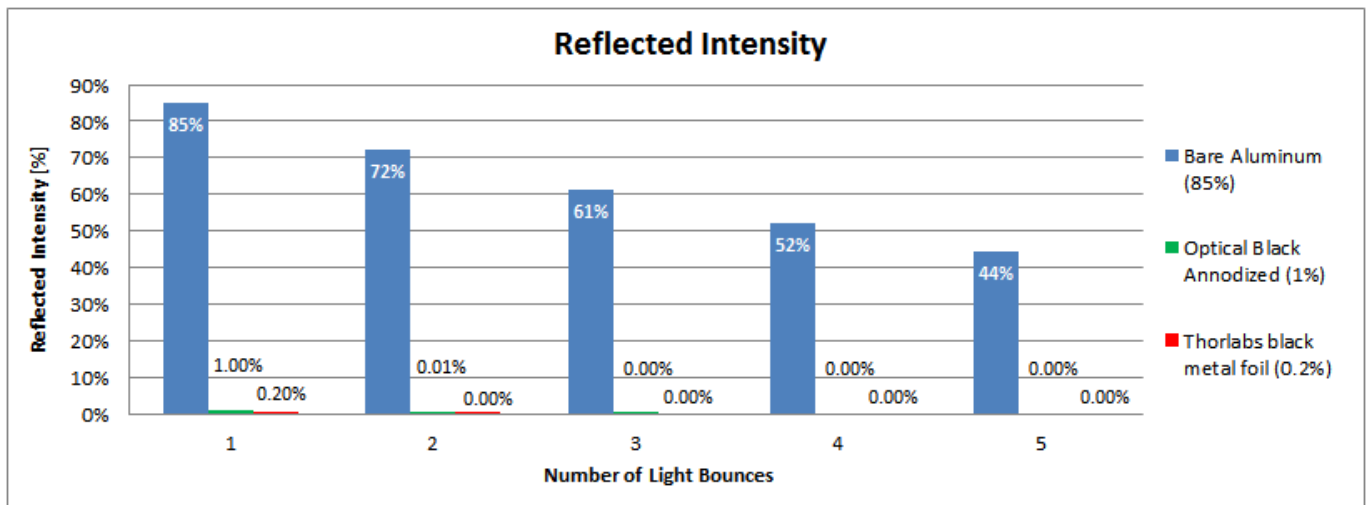
Light Baffle Examples (not to scale)

Adding a light baffle creates a surface to catch the reflected light beams and prevents them from reflecting (bouncing) off of other materials in the system and reduces the light spread.

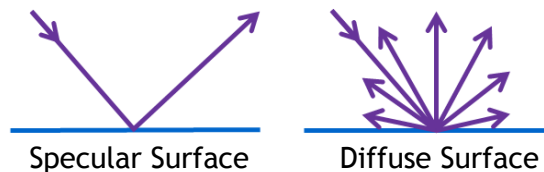


Materials

As stated above, avoid reflective materials such as bare Aluminum, as it has a UV reflectivity rating of 85%, whereas a surface that has been anodized optical black has a UV reflectivity rating of 1% and the Thorlabs black metal foil has a rating of 0.2% (see chart below). The intensity of the light will decrease every time it reflects (or 'bounces') off of a surface.



The surface finish of the material also affects how the light spreads. A specular surface is a smooth, mirror-like finish that allows a light beam to remain intact as it reflects off of the surface. A diffuse surface is a rough, textured finish that scatters the beam, causing the beam to reflect in many different directions. An example of a specular surface could be a mirror or polished metal. An example of a diffuse surface could be paper or textured paint.

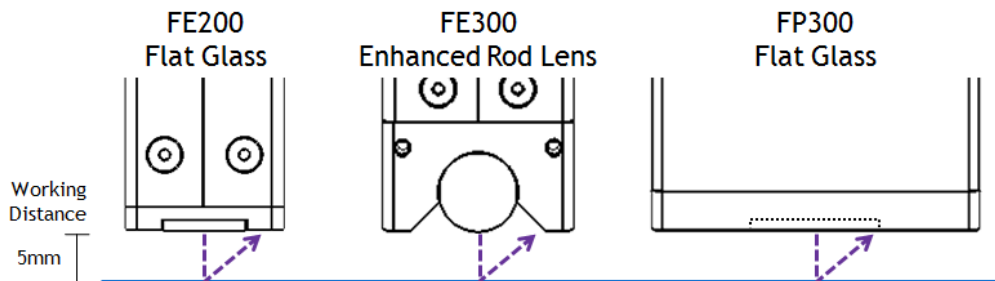


Light Reflection Examples

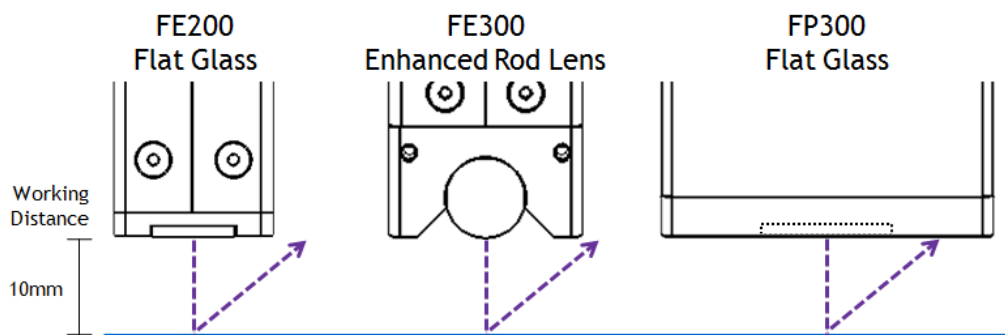
When curing with a reflective surface, like bare or polished aluminum, the size of the window frame and the working distance from the emitting window to the media, will affect how much light is allowed to reflect past the light source. Adding a light catch or shield that extends past the light source will catch some of this reflected light.

The amount of reflected light from a light source will vary based on the setup including:

- The peak intensity of the light source: directly correlates to the intensity of the reflected light, especially on a specular surface
- The type of window frame and optic: a focused light like the FE300 concentrates the light into a smaller area on the surface, where the FE200 Flat Glass and FP300 allows the light to spread due to the half-angle of the light output
- The working distance height between the light source and media: a larger working distance allows more room for the light to reflect past the emitting window frame
- The type of media surface: a highly reflective specular surface will reflect light more intensely than a non-reflective diffuse surface



Phoseon Product Examples at 5mm Working Distance

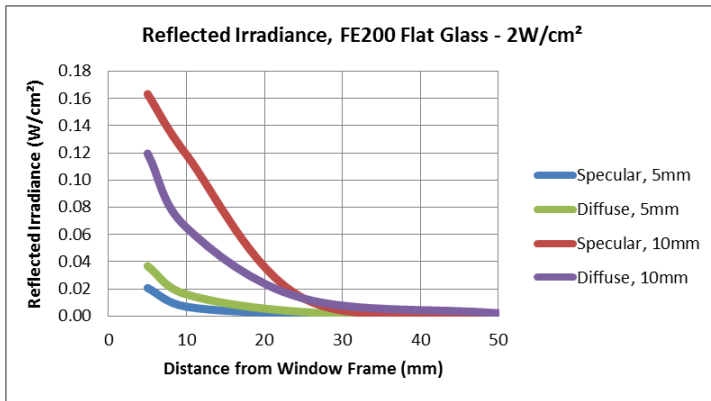


Phoseon Product Examples at 10mm Working Distance

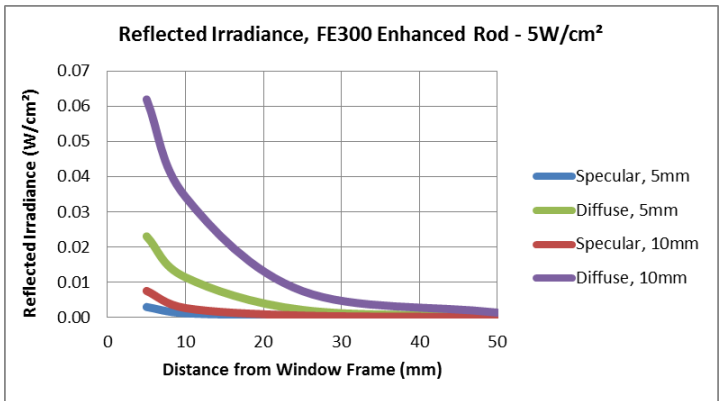
The charts below illustrate the irradiance values of reflected light with 3 different light sources; the FE200-2W/cm² with Flat Glass, the FE300-5W/cm² with Enhanced Rod Lens, and an FP300-20W/cm².

- The media is shown as a worst-case scenario with 100% reflectivity, meaning the media is not absorbing any of the UV energy, even if it is a specular or diffuse surface
 - For comparison, bare aluminum is 85% reflective as shown in the previous chart
 - In actual use, most surfaces will absorb some of the UV energy, which is either used to kick off a UV reaction (inks, coatings, or adhesives), or turns into heat
- The media is shown in two forms: a specular (smooth) surface and a diffuse (rough) surface

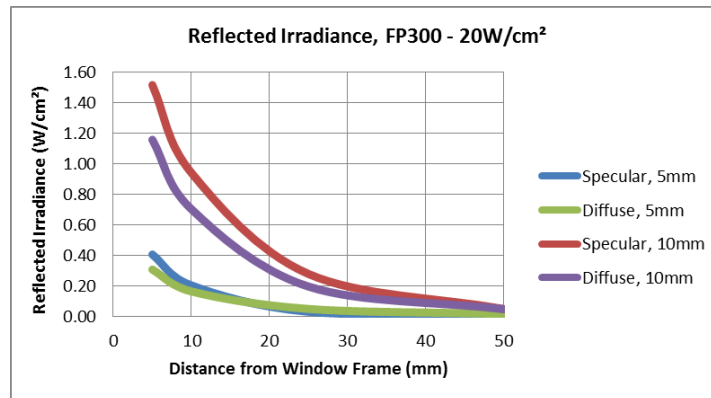
- Each media type is shown at two different working distances: 5mm and 10mm from the emitting window to the media
- The point of measurement for the reflected light is on the same plane as the emitting window at varying distances away from the edge of the light source (window frame, not the glass)



FireEdge FE200 Flat Glass, 2W/cm²



FireEdge FE300 Enhanced Rod, 5W/cm²



FirePower FP300, 20W/cm²

Observations from the charts above:

- The intensity of the light reflections from the FE200 are 10x less than the FP300, due to the difference in peak intensities (2W/cm² versus 20W/cm²)
- The FE300 has less intense light reflections and less specular reflection than the FE200 due to the Enhanced Rod Lens creating a narrower light output
- Other Phoseon products with 20mm emitting windows will have similar reflected irradiance patterns to the FP300, but the distance from the emitting window is different due to the width of the window frames

PLC & Ethernet Control

The light source can be controlled via a PLC (Programmable Logic Controller) using the DB-25 connection (see 30557 Product Specifications). The light source can also be controlled using the Ethernet interface via the RJ45 connector on the controller (see 30501, *Ethernet Protocol User Manual*). In addition, both PLC & Ethernet can be utilized simultaneously. For example, PLC can be used to control the light sources and Ethernet can be used to monitor the light sources.

Connecting an Override Circuit

The FireLine light source has the capability to support a customer-supplied override circuit. This is useful for situations where the function of the light source is tied to an enclosure or distance above a conveyor, where the UV emission should be stopped when a door is opened or if the light source is raised a specified distance above a conveyor. An external interlock circuit is not required for light source operation. If the light source is connected to an external customer-defined circuit, then this circuit should be tied to Pin 15. When 0V to +6V is applied to Pin 15, UV emission is stopped.

As an added safety measure, the use of a water flow switch is highly recommended. A flow switch inserted at chiller's water path output will guard against enabling the UV output when the water flow is off. The output of a flow switch is a simple contact closure. By choosing a switch that is normally closed when no water is flowing, it can be connected to the Controller Ready/UV Override Pin (Pin 15) of the light source controller. The flow switch may be replaced by an equivalent function in an integrated control system. Phoseon recommends the Gems Sensor, NC (normally-closed), 0.5GPM (2LPM) flow switch: PN 129666.

Connecting Multiple Signals

If multiple light sources are used with a single controller, the following Pins can be wired together so that one DB-25 interface can be used to control all the light sources in unison:

- Pins 3, 4, 8, 18 (Enable High)
- Pins 6, 11, 16, 21 (Intensity Control)
- Pins 4, 9, 19, 24 (Lamp Ready)
- Pins 5, 10, 20, 22 (Temperature Monitor)
- Pins 1, 13 (Ground)
- Pin 15 (Controller Ready/UV Override), when using multiple controllers

CAUTION: DO NOT wire together the following signal Pins:

- Pin 14 (+24 Reference)
- Pin 2, 7, 17, 22, 12 (Do Not Connect)

Controller LED Indicators

The FL200 controller is designed with two LED indicators, as described in the table below. The location of the LEDs is shown in Figure 2.1.

Table 2.2: FL200 Controller LED Indicators

LED Indicator	Functionality
Power/Light Source Ready	Solid green when power is applied to controller. Flashing green when light source(s) is detected.
Ethernet Ready*	Solid amber when IP Address is acquired and Ethernet communication with controller is ready.

*Applicable only if Ethernet communication is being used.

Controller Buttons

The FL200 controller is designed with two buttons, as described in the table below. The location of the buttons is shown in Figure 2.1.

Table 2.3: FL200 Controller Button Functionality

Button	Functionality
CONFIG	The CONFIG button resets the FL200 controller's network configuration back to a default state. To Reset the controller, hold the CONFIG button while the controller is booting up (either via a power cycle or a reset).
Reset	The reset button causes the FL200 controller to reset, which will force any existing faults to be cleared and any existing Ethernet communications to be dropped. Note: The Ethernet connection is not automatically re-established unless using a third-party software that attempts the reconnection.

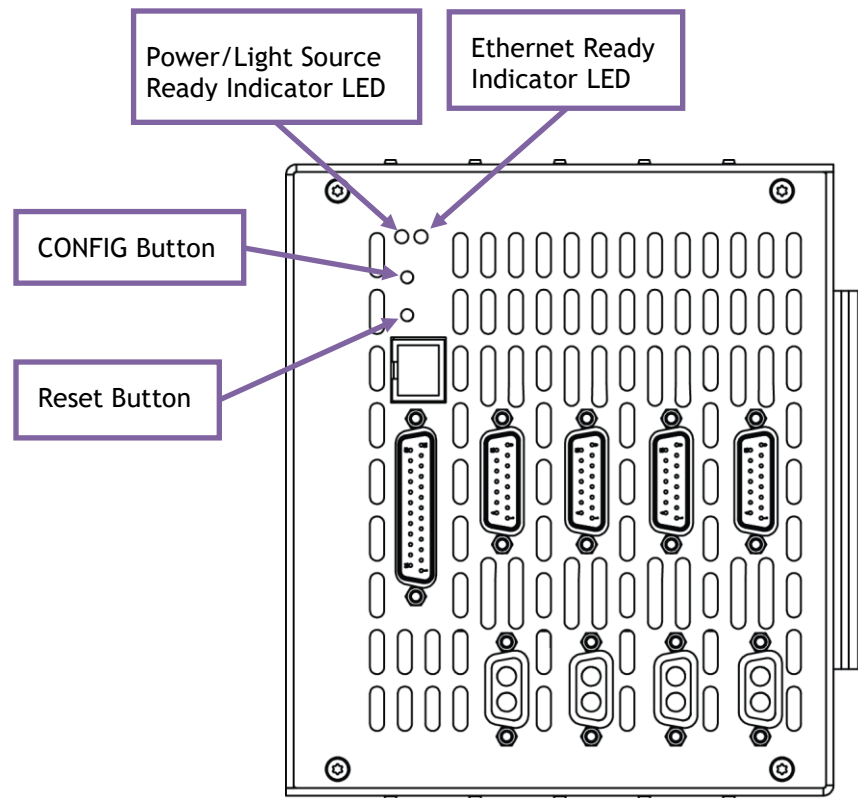


Figure 2.1: FL200 Controller LED Indicators and Button Locations

Water Tubing

Make sure the desired water temperature can be maintained (see 28384 Water Cooling Requirements). The FireLine FL200 has a 1/8in NPT thread fitting, but comes standard with push-to-connect fittings for 8mm OD tubing. Tubing should be compatible with the fittings being used.

Note: If required, the standard push-to-connect fittings can be removed and replaced with compatible 1/8in NPT thread fittings. Ensure that thread tape or pipe dope is used to prevent leaks and the tubing used is compatible with the fitting.

Operation

On/Off Control

The UV output of the light source is enabled and disabled through a simple PLC level voltage on the controller and is turned on and off electronically. The light source does not require external shutters and is enabled only when needed.

Caution: Any material exposed to UV, when not in motion, can reach very high temperatures as it absorbs the UV energy. Turn off the light source when not actively UV curing.

Intensity Control

The intensity of the UV output is controlled through an analog voltage. The valid range of this voltage is 0.1 to 10Vdc. 10Vdc corresponds to 100% output irradiance and UV power and 0.1Vdc corresponds to 1% output irradiance and UV power.

The output of the FL200 varies linearly from 0% to 100% for intensity control voltages between 0.0Vdc and 10Vd. If no UV output is desired at 0%, the enable line should be pulled low. Performance of the FL200 below 0.1Vdc and above 10Vdc is not specified.

Fault Feedback Outputs

The status of the FL200 is given by the state of the Lamp Ready line. The Lamp Ready signal is high (24V) when the FL200 is in the Ready state, meaning the UV output may be enabled through the Enable line. If the Lamp Ready signal is low (0V), the FL200 is in the Not Ready state, indicating the UV output will not enable.

The Not Ready state is caused by one or more of the following conditions:

- The FL200 DC power supply is turned off.
- The FL200 DC power supply is providing a voltage too low or too high for proper operation.
- The FL200 is in thermal shutoff due to excessive internal temperatures.
- The Controller Ready/UV Override is pulled low.

Refer to the troubleshooting guide later in this manual for help identifying the cause of the Not Ready state.

Irradiance as a Function of Distance

The UV emission from the FL200 UV light source diverges with distance away from the window glass. However it is important to note that as the distance between the media and the emitting window increases, the total energy (dose) delivered by the light source remains constant. Peak irradiance decreases as the working distance increases, but it is offset by an increase in the exposure area (light footprint), keeping the dose constant.

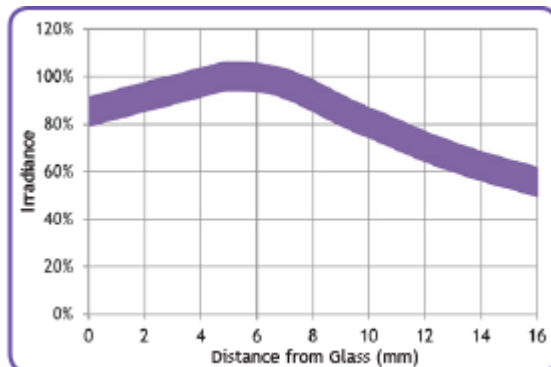


Figure 3.1: Irradiance as a Function of Distance

Monitoring Temperature

The performance of the FireLine FL200 light source, which is a water cooled system, will be directly impacted by the temperature of the cooling water and flow rate. Irradiance will increase slightly at cooler operating temperatures, for example at initial system start up.

Therefore, a temperature monitoring device has been integrated into the system to help monitor light source temperature during operation. The device inside the unit outputs a voltage signal of 0 to 7.5Vdc, which corresponds to 100mV per degree Celsius. For example, a reading of 2.55V equates to 25.5°C.

Phoseon recommends that the customer monitor the temperature, via the Temperature Monitor Pins, through the DB-25 connector. If the reported temperature changes by more than 10 to 15 degrees from steady state operating conditions, this could indicate a problem and the environmental conditions should be inspected. See Troubleshooting Guide later in this manual for more information.

In addition to monitoring the system temperature, the light source will shut down the emission of UV light when it has exceeded a safe operating temperature. The light source will shut off to prevent a thermal run away condition and the Lamp Ready will go low (not ready).

Note: When a temperature fault occurs, the light source will shut off automatically. If an enable signal is present, the light source will turn back on automatically when the operating temperature has returned to an acceptable value.

Do not exceed the water temperature specifications as indicated in 28384 Water Cooling Requirements.

Service

For further details contact Phoseon Technology by phone at +1.503.439.6446 or email at customerservice@phoseon.com.

Troubleshooting Guide

Table 4.1: Troubleshooting Guide

Symptom	Component	Action or Cause
No light is emitted from light source	Power Supply	Check that AC and DC cables are wired correctly to power supply: 1. If using Mean Well Power Supply, check that the green LED indicator is on and the fans are running 2. Check power supply is plugged into AC outlet 3. Verify voltage at the Controller for input to light source used is +48Vdc
	Temperature Fault	If light source has thermally tripped, no light will be emitted until the light source returns to a safe operating temperature (see Cooling Water below).
	Light Source with PLC Control	For trouble-shooting the DB-25 connections (see 30557 Product Specifications), the light source can be enabled without using a PLC. To turn on the light source at full intensity when power is applied make the following connections: 1. Enable light source: Ensure +24V is supplied to Enable High 2. Provide full intensity: Tie Intensity Control to +24V Reference
	Not Ready Fault	Check wiring to DB-25 connection (see 30557 Product Specifications). If the output is at a ground state (0 to 6V), the light source's internal fuse could be blown, contact Phoseon for more information.
Change in light source temperature of more than 15°C	Cooling Water	Check the light source temperature, at the temperature output signal, with a digital multi-meter to measure the voltage (0.1V/°C): 1. Check there is sufficient water flow, see 30557 Product Specifications 2. Check water temperature is at the desired setting (see 28384 Water Cooling Requirements) 3. Check water temperature of the light source is less than 35°C if light source has recently thermally tripped (<5min)
Film on inside of emitting window	Cooling Water	Check the environment around the light source is not conducive to condensation. The film could be water accumulating on the inside of the light source due to humid conditions. See 28384 Water Cooling Requirements for more information on avoiding condensation.

Window Cleaning Instructions



User Guide

Phoseon requires inspecting and cleaning the emitting window of the light source for any debris or UV material on a regular basis, up to daily if needed, to maintain the quality of UV light output.

Note: Do not submerge the light source or spray any liquid directly onto the light source.

The materials needed to properly clean the Phoseon light source, can be purchased from most home improvement supply stores, paint stores, or auto-body repair shops.

Materials Needed:

- Dry Paper Towels
- Razor Blade and Handle
- IPA Pre-moistened Wipe
- Gloves: Vinyl and Sharp Resistant (i.e. Kevlar)
- Sharps Disposal Container

Instructions:

1. Disconnect DC Power from the light source.

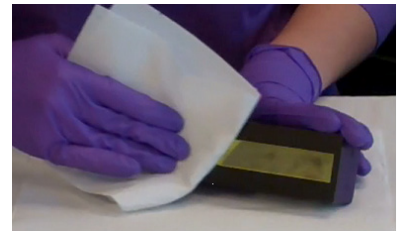
CAUTION: Wearing vinyl gloves is recommended to avoid getting any uncured UV material on the skin.

2. Wipe down the glass with a dry paper towel to remove any uncured UV material.
3. Carefully scrape large debris off the window using the sharp edge of the razor.

CAUTION: Wear sharp-resistant gloves.

Note: If the razor needs to be replaced, dispose of the razor blade in a properly marked sharps container.

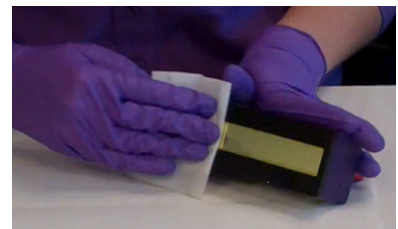
4. Use the pre-moistened IPA wipe to remove any remaining dust or debris left on the window during the cleaning process.
5. Repeat steps 2 through 5 until the window is clear of all contaminants.
6. If needed, use a dry paper towel to wipe down the light source.



Wipe Glass



Scrape with Razor



Wipe with IPA

Declaration of Conformity (CE)

Product Identification



Brand	Phoseon						
Product Family	Product Models						
FireEdge™	75x5 FE100 80x10 FE200 75x10 FE300 75x10 FE400 80x10 FE410 80x10	FE100 120x10 FE200 110x10 FE300 110x10 FE400 120x10 FE410 120x10	FE100 180x10	FE100 240x10 FE400 180x10 FE410 180x10	FE400 240x10 FE410 240x10		
FireFlex™	75x50	150x50	225x50				
FireFly	25x10 50x20 FF200 25x20	25x20 75x20 FF200 50x20	25x25 150x20				
FireJet™	225x20 ONE 75x20 FJ100 75x20 FJ100 G2 75x20 FJ240 75x40 FJ601 225x20 FJ605 300x20 FJ800 100x100 FJ801 100x100	ONE 150x20 FJ100 150x20 FJ100 G2 150x20 FJ200 150x20 FJ240 150x40 FJ601 300x20 FJ605 375x20	FJ50 225x20 ONE 225x20 FJ100 225x20 FJ100 G2 225x20 FJ200 225x20 FJ200SLD 225x20 FJ228 225x20 FJ240 225x40 FJ601 375x20 FJ605 450x20	ONE 300x20 FJ100 300x20 FJ100 G2 300x20 FJ200 300x20 FJ240 300x40 FJ601 450x20 FJ605 525x20	ONE 375x20 FJ100 375x20 FJ100 G2 375x20 FJ200 375x20 FJ240 375x40 FJ601 525x20 FJ605 600x20	FJ605 675x20	
FireLine™	125x20 350x20 FL200 75x10 FL400 125x20 FL400SLD 125x20 FL440 125x40	150x20 450x20 FL200 125x10 FL400 150x20 FL400SLD 150x20 FL440 150x40	225x20 550x20 FL400 225x20 FL400SLD 225x20 FL440 225x40	300x20 675x20 FL400 250x20 FL400SLD 250x20 FL440 250x40	FL400 300x20 FL400SLD 300x20 FL440 300x40		
FirePower™	FP200 150x20 FP300 150x20 FP501 300x20 FP601 300x20	FP200 225x20 FP300 225x20 FP501 350x20 FP601 350x20	FP200 300x20 FP300 300x20 FP501 450x20 FP601 375x20	FP200 350x20 FP300 350x20 FP501 525x20 FP601 450x20	FP200 450x20 FP300 450x20 FP501 600x20 FP601 525x20	FP300 900x20 FP501 700x20 FP601 600x20	FP601 675x20
KeyPro™ Explorer	25x10						
StarFire™	100x20	150x20					
StarFire MAX™	75x20	150x20	225x20	300x20			

Manufacturer

Name: Excelitas Technologies
Address: 7425 NE Evergreen Parkway, Hillsboro, Oregon 97124-5845
Country: United States of America

Means of Conformity

Excelitas Technologies declares that the product listed as a result of its design and construction is in conformity with the essential requirements and provisions of the following Council Directives and standards:

Applicable Directives:

- 2014/35/EU (Low Voltage Directive)
- 2014/30/EU (Electromagnetic Compatibility)
- 2011/65/EU (RoHS2)

Standards Used to Verify Compliance:

- EN 61010-1:2010/A1:2019/AC:2019-04/A1:2019
- EN 62471 (2008) IEC 62471 (2006)
- EN 61326-1 (2013)

Signature

Signature (electronic): Rob Gomeau

Name: Rob Gomeau, Director of Operations

Place : Hillsboro, OR